# Measurements of the High Energy Gamma-Ray Flux at SNO

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High energy gamma rays are an important background for both reactions of neutrino detection in SNO, neutral and charged current reactions. Compton scattering and/or pair production of high energy gamma-rays can mimic the electron produced in the charged current reaction. The photodisintegration of the deuteron can produce background neutrons to the neutral current reaction signal.

Our goal with this work is to evaluate the high energy gamma-ray flux induced from U and Th long lived isotopes, from the $(\alpha, \gamma)$, $(\alpha, n\gamma)$ and $(\alpha, p\gamma)$ reactions in the rock. This new measurement of the gamma-ray flux was performed after the cavity was completed and coated with low activity concrete and the final sealing plastic liner, Urylon.

The detector used to measure the gamma-ray flux inside the SNO cavity was a 19 cm diameter by 15 cm thick NaI crystal to which three 3-inch photomultiplier tubes (PMT) were attached. The gains of the PMT were matched and the signals all of the PMTs were summed and fed into a ORTEC-NOMAD, a portable data acquisition system. We acquired data in this configuration for 1490 hours in the bottom of the SNO cavity. Shielded background runs were performed at the 4600 ft level low background facility of the Creighton mine.

Figure 1 shows the comparison between spectra obtained with the same detector at different sites: at the LBNL Low Background Facility on Bldg. 72 (sea level), at the Oroville Low Background Facility (700 meter-water-equivalent) and at the SNO cavity (6000 meter-water-equivalent).

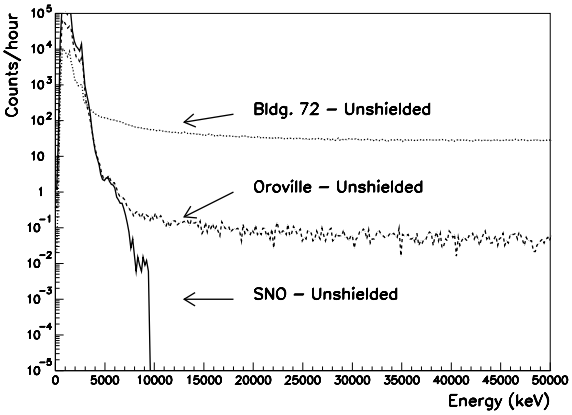


Figure 1: Comparison between spectra obtained at sea level (dotted line) at the Oroville Low Background Facilty (dashed line) and at the SNO cavity (full line).

In table 1 we present the comparison of the fluxes of the gamma-ray lines, 1460 keV from $^{40}$K decay and 2614 keV from $^{208}$Tl decay obtained in 1994 and recently in 1996.

Table 1: Measured Fluxes - 6800 ft Level

| $E_\gamma$ (keV) | Flux 3/94 $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ | Flux 5/96 $\mathrm{cm}^{-2}\mathrm{s}^{-1}$ |
|---|---|---|
| 1460 | $0.059 \pm 0.003$ | $0.061 \pm 0.006$ |
| 2614 | $0.016 \pm 0.001$ | $0.0075 \pm 0.0007$ |

Based on the measured spectra, on the measured detector's intrinsic background and on the measured detector's intrinsic efficiencies the expected flux of gamma-rays from the cavity walls above 5 MeV in the SNO cavity is $3.4 \times 10^{-3}$ gammas/cm $^2$/hour, while previous estimatives based on Monte-Carlo and the rock contaminants quote $1.4 \times 10^{-3}$ gammas/cm $^2$/hour[1]

*Footnotes and References*

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[†]Die Arbeit wurde mit einem Stipendium des Gemeinsamen Hochschulsonderprogramms III von Bund und Landern uber den DAAD ermoglicht

*Footnotes and References*

[1]P. Skensved and B.C. Robertson, SNO internal report.